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# Idempotent

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In mathematics an **idempotent element**, or an **idempotent** for short, is anything that, when multiplied by itself, gives itself as result. For example, the only two real numbers which are idempotent are 0 and 1.

Formally, if  $S$  is a set with a **binary operation**  $*$  on it, then an element  $s$  of  $S$  is said to be idempotent if

$$s * s = s.$$

In particular, any **identity element** is an idempotent under  $*$ . If every element of  $S$  is idempotent, then the binary operation  $*$  is said to be idempotent. For example, the operations of set union and set intersection are idempotent.

A **function**  $f$  from a **set**  $M$  to itself is called idempotent if  $f \circ f = f$ , that is,  $f(f(x)) = f(x)$  for all  $x$  in  $M$ . This is equivalent to saying that  $f(x) = x$  for all  $x$  in  $f(M)$ . Trivial examples of idempotent functions on  $S$  are the **identity map** and the constant maps. Less trivial examples are the **absolute value** function of a **real** or **complex** argument, and the function which assigns to every subset  $U$  of some **topological space**  $X$  the **closure** of  $U$ . The latter is an idempotent function on the **power set** of  $X$ . It is an example of a **closure operator**; all closure operators are idempotent functions.

In **linear algebra**, **projections** are idempotent. That is, any **matrix** that projects all vectors onto a subspace  $V$  (not necessarily orthogonally) is idempotent, if  $V$  itself is pointwise fixed.

A **ring** in which multiplication is idempotent ( $x^*x=x$ ) is called a **boolean ring**. It can be shown that in every such ring, multiplication is commutative, and every element is its own additive inverse.

In **computing**, idempotence is the quality of something that has the same effect if used multiple times as it does if used only once. This is but a special case of the mathematical concept defined above. In particular, **C** header files are often designed to be idempotent, that is, if the header file is included more than once (as can easily happen with nested `#includes`), then nothing untoward happens - the effect is the same as if it had been included only once. In **HTTP**, some methods (such as GET) are idempotent, while other methods (such as POST) are not.

In user interface design, a button can be called "idempotent" if pressing it more than once will have the same effect as pressing it once. For example, a "Pause" button is not idempotent if it toggles the paused state. On the other hand, if pressing it multiple times keeps the system paused and pressing "Play" resumes, then "Pause" is idempotent. This is useful in interfaces such as infrared remote controls and touch screens where the user may not be sure of having pressed the button successfully and may press it again. Elevator call buttons are also idempotent, though many people think they are not.

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[Go](#) [Search](#)

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## Alphabetical Index

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y
Z				

## Category Index

- Art
- Biology
- Chemistry
- Engineering
- Physics
- Geology
- Human Sociology
- Information Science
- Language
- Life Sciences
- Nanotechnology
- Philosophy
- Reason
- Astronomy
- Transhumanism
- Xeno Life

### idempotent operation // Computer Science

1. An operation is idempotent if repeated applications have the same effect as one. 2. This term can be used to describe C header files, which contain common definitions and declarations to be included by several source files. If a header file is ever included twice during the same compilation (perhaps due to nested #include files), compilation errors can result unless the header file has protected itself against multiple inclusion; a header file so protected is said to be idempotent. 3. The term can also be used to describe an initialization subroutine that is arranged to perform some critical action exactly once, even if the routine is called several times.

Mathematically,  $f(f(x)) = f(x)$ , such as  $f(x) := x * 1$ , or  $f(x) := x \& x$ .

In NFS, a stateless server, idempotent operations protect the server from duplicate requests.

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